A Brief History of Computers

Computing devices - from ancient things to modern systems

Generations of Computers

• Computing hardware is grouped into generations, according to the technology in use:
  - “0th” – Primitive devices
    » Pre-industrial
    » Electro-mechanical
  - 1st – Vacuum-tube electronic circuits
  - 2nd – Solid-state devices
  - 3rd – ICs (Integrated Circuits)
  - 4th – VLSI (Very Large-Scale Integration)
Generation 0: the earliest devices

- Writing, Counting aids
  - cuneiform records of crops, taxes, etc.

- Adding machines
  - the Abacus

a recent discovery

- the Antikythera mechanism
  - discovered in 1900, in the Mediterranean
  - complexity suggested Middle Ages or later
  - understood in 1970s: it dates back to 100 B.C.

- Astronomical calculations
  - computed dates for Olympic Games
Some of the original; a reconstruction

1600's - logarithms and the slide rule

- John Napier described logarithms in 1614, and used them in a calculating device called "Napier's Bones" (shown at right).

- William Oughtred used logarithms to invent the slide rule in 1622.

In 1992 I traded my old Z-150 (Intel 8088-based) personal computer for this 14-inch long slide rule, which had belonged to a friend's father.

More info:
http://www.geo.tudelft.nl/mgp/people/gerold/indnap.htm
http://www.hpmuseum.org/sliderul.htm
1834: Charles Babbage

• Difference Engine (+,-)
  - Navigational tables as a national priority
  - Programmable by adjusting connections
  - Never fully completed

• Analytical Engine (General Purpose)
  - Store (1000 x 50 digit-registers)
  - Mill (Computational Unit)
  - Input and Output via punched cards
  - Multiple steam engines to turn the gears

Generation 0.5: Electromagnetic Machines

• Some computing devices from the mid-1900s used relays
  - electro-mechanical switches: like a light switch, but controlled by electrical signal
  - still used for high-current applications
WWII Germany

• Konrad Zuse – the Z1, Z2, Z3, Z4
  - Z1 completed in 1936
  - 64-word memory
  - 22-bit floating-point calculations
  - telephone relays
• right: the Z1 reconstructed

Harvard Mark I

• 1944: Howard Aiken (Mark I)
• like Babbage’s design, but used relays:
  - A store of 72 words with 23 digits
  - Instruction time of 6 seconds
  - Input and output using paper tape
Generation 1: Vacuum Tubes

- Faster and cheaper than relays
- Less electrical power needed
- left: a triode; right: a memory unit

The “First” Computers

- 1943: COLOSSUS
  - British military code-breaking secret
  - The first electronic digital computer?
  - 1500 vacuum tubes
  - Replica built in 2007
ENIAC – first of the “mainframes”

• 1946: **ENIAC**
  - University of Pennsylvania
  - 20x10 digit memory
  - 17,468 vacuum tubes
  - 1500 relays
  - 27 tons
  - 1800 square feet

UNIVAC, 1951

• Early mainframe used to predict the outcome of the 1952 presidential election
Generation 2: Transistors

• Faster, cheaper, more reliable
• 1st transistor invented 1947
  - Bell Labs, Cherry Hill, NJ
  - Vacuum tubes obsolete by mid-1950s

“Solid-State” Computers

• Solid-state: no moving parts, no breakable glass tubes
• 1961: PDP-1, first minicomputer
• 1963: Burroughs B5000, special features for software
• 1964: CDC 6600, first scientific supercomputer
• 1965: PDP-8, used the Omnibus to connect components
Digital Equipment Corporation: PDP-1 and PDP-8

- above: PDP-1 featured a CRT display
- right PDP-8 with printer

Generation 3: Integrated Circuits

- Dozens of transistors on one chip
  - 1958: Jack Kilby at TI
  - Faster, cheaper, smaller...
  - individual transistors as small as a human hair
Computers become widespread...

- **1964:** *IBM System/360*, the first computer family
  - Widespread for businesses
  - Models leased for $2700 - $115,000 per month

- **1970:** *PDP-11*, 16-bit successor to the PDP-8 (another family)
  - Hugely popular with universities

DEC again: the PDP-11

- Evolved from a 2nd-generation, transistor-based machine into an integrated-circuit design
- Versions spanned a 20-year lifetime
Generation 4:
Very Large Scale Integration

• The next step in integrated circuits
• Thousands -- billions of transistors per chip
  - Faster, smaller, cheaper…
• 1971: entire “CPU” (processor) as one circuit
• The era of the personal computer

Early Personal Computers

• Also known as microcomputers
  - compared to mainframes, minicomputers
  - textbooks still use this word

• left: the Apple II; right: an early portable computer
The 4th Generation Continues

- VLSI microprocessors are ubiquitous
  - laptops, tablets
  - smartphones
  - televisions
  - "smart" appliances

- The most advanced circuits employ transistors that are 22 billionths of a meter in size

Recap:

- Computing hardware is grouped into generations, according to the technology:
  - "0th" – Primitive devices
    » Pre-industrial; relay-based electro-mechanical
  - 1st – Vacuum-tube electronic circuits
    » “One-off” custom-designed machines
  - 2nd – Solid-state devices
    » The mainframe era
  - 3rd – ICs (Integrated Circuits)
    » Cheaper machines for smaller organizations
  - 4th – VLSI (Very Large-Scale Integration)
    » Personal computers, high-powered systems